ON THE

Infectious Origin and Propagation

OF

CHOLERA.

BY

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PREFACE.

The following paper was read at the first two meetings of the Epidemiological Society, held on Monday the 2nd of December, 1850, and Monday the 6th January, 1851. It is now, by permission of the Right Honourable the Lords Commissioners of the Admiralty, printed in its original form.

Fully aware of the responsibility which attaches to any individual who ventures to promulgate opinions with respect to the propagation of infectious diseases at variance with those recognised and adopted by Her Majesty's Government for the regulation of quarantine, I nevertheless do not fear to incur that responsibility, feeling assured that the views which I have adopted are fairly deducible from premises that cannot be questioned; and that they will meet with the support of a large proportion of the most intelligent members of the medical profession. The non-extension of a disease in every instance does not prove that it is not infectious; it simply shows that in these instances it did not extend; on the other hand, if it can be but once established that a disease has extended from a personal source, or a centre of personal infection, we shall then be justified in concluding that, under the same amount of morbid action, it

will invariably be endowed with infectious properties; hence the question as to the propriety of omitting quarantine measures with respect to Cholera.

The Report published by the Board of Health has most satisfactorily proved that Cholera has been most destructive in places abounding in filth,—a point of the greatest importance; but to arrive at anything like a satisfactory conclusion as to the influence of filth, we should require to know the whole of the localities clean, as well as filthy, in which it appeared; and in the same manner those in which it did not show itself. We should then be better able to judge how far accumulations of filth in certain localities favour the eruption or extension of the disease, and also to compare the evidence in favour of its being produced and propagated by an epidemic constitution of the atmosphere, depending on causes, not of a personal character, with that in favour of its being produced and propagated by a similar condition of the atmosphere, caused by an infectious personal virus.

A. BRYSON.

Somerset House,
June 27th, 1851.

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On the decline of cholera, in the autumn of 1849, as great contrariety of opinion still appeared to exist respecting its primary source or cause, its modes of propagation or extension, and also as to the various remedial measures which had been employed in the treatment of that formidable malady, the Director-General of the Medical Department of the Navy caused a circular letter to be sent to those medical officers who were known to have had the best opportunities for observing and studying the nature of the disease during its recent invasion, calling on them, in connexion with other questions, to state whether in their opinion there had been, during the two or three preceding years, any atmospheric cause in existence sufficient to account for the general prevalence of cholera throughout the kingdom; and, whether, if they had been led to believe in the existence of an epidemic cause, they considered its influence on the human constitution had, in particular districts, been increased or aggravated by the presence of local causes, such as effluvia, gases, or vapours. If they considered the disease to be contagious or infectious, they were requested to state in detail the principal facts which, from their own experience, they could bring forward in support of that opinion.

A considerable number of reports, containing much valuable

information, were thus placed at the disposal of the Director-General; these it is now proposed to examine, in order if possible to determine, from the facts detailed, what are the proofs in favour of the disease originating from an epidemic cause or constitution of the atmosphere; and, in contradistinction, what evidence there is in favour of its being a disease which, like small-pox and measles, occurs occasionally from natural but unknown causes, and propagates itself by means of a specific virus, emanating from the bodies of the sick. In commencing this inquiry it will, in the first place, be necessary to make some extracts from those reports, in which local and apparently independent eruptions of the disease have been described; and then to give in detail the opinions of the several reporters, taking them up, as nearly as possible, in their order of date, that is, according to the date of the occurrences described, so that they shall not be out of place in the chronological scale of the epidemic.

The first, then, to be noticed is from Mr. Verling, the surgeon of Haulbowline Hospital, at the Cove of Cork, or, as it is now called, Queenstown. In this Report it is observed, "I am not aware of any peculiarity having existed in the state of the atmosphere during the two or three last years, which could have been assigned as a cause for the outbreak of cholera." The first case was received into the hospital in March, 1849, and necessarily created great alarm, as the disease had not then approached within a considerable distance of Cork. The patient (a boy) was brought from the Avon steam-vessel, which had only left Limerick on the preceding day. Cholera was then raging in Limerick, and the patient, while the vessel lay there, had been repeatedly on shore, and in those parts of the town where it was most prevalent. He recovered, and no other case occurred at that time, either in the hospital or in Queenstown, or in the steamer.

About the middle of May, however, cases began to occur in Queenstown, infesting more especially the low, damp, and dirty parts of it; it is observed that "nearly all the seamen received into the hospital had spent their period of leave in one of these localities, pre-eminent above all the others for

its offensive effluvia and want of ventilation. The patients after their reception into the hospital, were kept in a ward by themselves, but no great restriction was enforced as to intercourse with other persons in the establishment, and none of the inmates contracted the disease." Hence it was inferred that "in the ordinary acceptation of the term it was not infectious, but that it resulted from local causes." The same mode of reasoning, whether correct or not, is applicable to the case of the boy who was seized on board the Avon, after exposure on shore at Limerick. The impossibility of separately distinguishing the effects produced by local and personal causes effectually precludes the possibility of assigning these and similar cases exclusively to one or the other of these sources, while the non-propagation of the disease in the hospital and steamer might lead to the inference that it was not infectious.

With respect to the first appearance of the disease at Plymouth, it is proper to state, that so early as the 9th of April a female convict-ship anchored in the Sound, in which several deaths from cholera had occurred during her passage from the Thames. She remained in quarantine until the disease ceased, and then proceeded on her voyage. In this instance, the disease did not extend to the shore, or to the shipping in the neighbourhood. Towards the end of May, however, a small fishing-smack from Dieppe arrived at Noss, a village situated on the estuary of the river Yealm, about six miles distant from Plymouth. None of her crew were actually ill of cholera when she arrived, nor had any of them suffered from it on the passage, but the disease was prevalent at Dieppe when she left. The first person from Noss who visited this vessel remained in her some time and drank a quantity of brandy. On landing, he was seized with cholera, which carried him off in nine hours. The disease then immediately afterwards broke out simultaneously at two opposite sides of the village, and rapidly spread all over it. This might be set down as a coincidence, but it would certainly form a very remarkable one.

On the 5th of June another vessel, the American Eagle, with emigrants on board, amongst whom the disease had

broken out on the passage from the Thames, anchored in the Sound. In this instance quarantine was not observed; the people on board landed, and mixed freely with the inhabitants of the town without communicating the disease to them, so far as was known. About this time, however, exclusive of Noss, scattered cases, which were attributed to the general epidemic cause supposed to be in existence in other parts of the country, began to occur in some of the adjacent villages; and in the beginning of July, the disease broke out in Plymouth; taking, according to one account, a westerly direction, it extended to Stonehouse; while, according to another, it first appeared in Stonehouse, secondly in Plymouth, and next in Devonport and Stoke. On the 12th of August it appeared at Torpoint, on the opposite side of the harbour; and on the 17th, at Kingsand and Cawsand.

With the exception of the apparent transmission of the disease from the fishing-smack to Noss, there does not appear to have been at the time any good grounds for believing it was propagated by infection. Although many cases were brought from without into the Naval Hospital at Stonehouse, yet not one of the residents or patients suffering from other complaints were attacked with the disease in its more malignant form.

"About the middle or the latter end of June, scattered cases began to occur in the neighbourhood of Chatham. One of these proved fatal in the parish of Stroud on the 20th; and early in July there were several fatal cases at Rainham, a village about four miles south east of Chatham; while almost simultaneously it made its appearance at Cliffe, six miles to the northward, and there was one case at Upnor, immediately opposite to the dockyard, on the north side of the river." According to our usual mode of reasoning respecting cholera, it was not deemed possible to attribute these cases to imported infection, or indeed to any other cause than that which was supposed to exist in the atmosphere hovering over the respective localities at the time. On the 29th, however, an itinerant musician, who had come from Gravesend, was found lying by the roadside, at a short distance from Chatham, ill of cholera; he was taken to the

Medway Union, where he died on the following day. In the course of a day or two afterwards, the man who attended him in his illness was seized with the disease, and died of it also. These appear to have been the first cases which occurred in Chatham; and Mr. Drummond justly observes in his report, that the occurrence of the one case so soon after the other is strong evidence in favour of the infectious theory.

No other case occurred in the workhouse for nearly a month afterwards, although, on the day following that on which the musician was found by the road-side, the 30th of July, three fatal cases were reported to have occurred in Church-lane, adjoining the marine barracks, and others immediately followed in other parts of the town. But it did not extend to Brompton nor to the Brompton barracks, which are considerably elevated above the rest of the town. In the latter, there were nearly 4,000 men, who almost entirely escaped, while the marines in a barrack at the base of the same height, and close to the Medway, suffered severely.

It would thus appear, that cholera must either be propagated by a specific personal virus; or, if it arise from terrestrial or atmospheric causes, that these are developed in circumscribed spots, and do not pervade the atmosphere generally, nor exist in it, unless in a modified form, for any great length of time. Otherwise, scattered cases would have occurred simultaneously all over the town, but more especially in places immediately to leeward of those in which cases were of daily occurrence. This view of the question is further strengthened by the following circumstance. Mr. Drummond observes that "from this period (the 30th of July,) garrison orders were issued, prohibiting any communication by the men in the several barracks with either of the towns, and this measure for a time seemed to preserve them from the epidemic."

A large number of cases were treated in Melville Hospital; but here, as at Plymouth Hospital, although, including patients, nurses, medical officers, and others, there were about three hundred persons within the walls of the establishment, and although there was constant and free communi-

cation with the cholera wards, at all hours of the day and night, the disease, in its malignant form, was not communicated to a single individual. Still, many of the residents suffered from diarrhœa, together with slight spasmodic twitchings of the muscles of the extremties.

Cholera broke out in the ship Havering while she was proceeding down Channel, on her way to Cork to embark prisoners for Van Diemen's Land. One of the soldiers of the guard was first attacked, early on the 20th of June, when she was about abreast of the Start Point; he had been ill of diarrhœa, however, two days previously. On the same day, another soldier was attacked, but not so severely; and on the 27th, the day following, a third had an attack of diarrhœa. Early on the morning of the 28th, the vessel being then off Plymouth, other two soldiers and three seamen were almost simultaneously attacked. Again, on the 29th, five seamen, and on the 2nd of July a soldier, were added to the list of cholera patients. No other decided cases of cholera occurred up to the 7th of July; but a number of cases of diarrhœa—undoubtedly minor effects of the same cause—occurred amongst both classes of men.

In nearly all the cases of cholera, the symptoms first attracted the attention of the patients shortly after midnight or early in the morning. The vessel was new, perfectly clean, and there were no offensive effluvia perceptible on board. The seamen were in bad condition; ill-clothed, too closely berthed, and some of them were not provided with bedding. The soldiers, however, amongst whom the disease first made its appearance, were in good condition, and well supplied with all the necessaries of life. The surgeon superintendent, the officer of the guard, the master and the mates, who occupied the cabins under the poop, and were necessarily, with the exception of the surgeon, in a great measure separated from the men, particularly during the hours when the attacks were most frequent, entirely escaped. On the 29th of June the seamen were removed from their badly-ventilated quarters under the forecastle into the prison. After this, with the exception of one slight attack, no more cases of cholera occurred, although diarrhœa, which however

assumed a milder form, continued to prevail until the 8th of July.

The surgeon, in this instance, did not consider the disease infectious; in a second report he hazards an opinion that it may depend on some change in the atmosphere—"very likely a deficiency of electricity."

The preceding are the principal facts which have been mentioned respecting what appeared to be separate and distinct eruptions of the disease. With reference to the second and third paragraphs of the Director-General's letter, the following extracts have been made from the reports, for the purpose of showing the various opinions held respecting the probable nature of the causes influencing its development in the first instance, and its subsequent epidemic extension in various directions over the country.

"I think there can be no doubt of the existence of an epidemic cause—from its gradual progress from India to Europe, and from its general diffusion over Great Britain and Ireland during the last nine months. I believe, also, that this complaint has been much increased in severity from local causes." "A case occurred in the Admiral's tender, lying off the principal sewer of Sheerness, which in all probability originated in that way, *i. e.*, from offensive effluvia, as no other case appeared on board of any of the ships in harbour. I do not consider cholera contagious under ordinary circumstances; but, where many patients are crowded together, and the ventilation is imperfect, it may, like some kinds of tropical fever, become highly contagious."(a)

"I think that everything connected with cholera seems to prove that it has its origin in places where it shows itself, and that the essential cause is evolved from the soil or subsoil, which, mingling with the air of the place, enters the system, producing mediately through the lungs its specific effect. The diffusion and aggravation of the disease is assisted by decomposing organic substances, but it is ex-

(a) Chas. Smith, Esq., Surgeon, R.N.

tremely doubtful whether these latter of themselves can excite it."(a)

"That a telluric or an atmospheric cause has been in operation for these last two or three years I think highly probable, taking into consideration the potato blight; but what it is remains as yet a mystery." "As to the contagiousness or non-contagiousness of cholera, the little experience I have gleaned, leads me to view it as non-contagious, (except, perhaps, when cases are congregated in masses,) for many of our workmen lost a part of their families—a few, the whole, while they themselves remained intact. This is something more than mere negative evidence, seeing that they were for part of the twenty-four hours exposed to the same exciting cholereal cause that produced the disease in other members of the family. Moreover, in many instances, one individual of a family has been affected without any of the others suffering. These circumstances could hardly take place, if cholera were of that contagious nature which some have asserted."(b)

"I am not aware of any conclusive evidence of the existence of any peculiarity of atmospheric constitution within the two or three last years sufficient to account for the general prevalence of cholera; but all I know about the disease leads me to believe in the existence of an epidemic cause, the influence of which seems to have been greatly increased or aggravated in particular districts by local causes, such as effluvia, gases or vapours." "I consider the disease to be neither contagious nor infectious; but under very unfavourable circumstances, such as over-crowding, imperfect ventilation, &c., it has sometimes seemed to be contagious."(c)

"It will be observed, that the variations of the thermometer were extensive on those days on which cholera and diarrhœa were most prevalent, and that the ranges of the barometer were low." "That the atmosphere carried a

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(a) Dr. Wilson, Inspector of Hospitals, &c.
(b) James Henderson, Esq., Surgeon, Dock-yard, Portsmouth.
(c) Dr. D. G. Miller, R.N.

poisonous quality was obvious, from the number of deaths. Although many of the intemperate and exhausted were carried off, still frequent deaths took place amongst persons on whom no such causes could have operated." "Although I do not consider that cholera depends upon personal communication and infectious influence for its propagation, I do not hesitate to allow that the products of cholera patients frequently prove prejudicial to the human body, as exemplified by the indisposition of medical men and nurses, induced during their attendance on the sick."(a)

"It is evident from cases about to be given, that it was increased by the intercourse of the inhabitants of this parish (Stonehouse) with those of Plymouth, and, consequently, must be contagious."(b)

"With respect to contagion or infection, it cannot be advocated from anything that has come under our notice in this hospital. Patients have been admitted in all stages of the disease, many of them from houses in Stonehouse, where it was sweeping away almost every inmate. The cholera wards were never left without the presence of a medical officer; the nurses were constantly hanging over the patients, lifting and assisting them in every way; unavoidably inhaling their cold breath, and pressing their hands upon the anus, restraining the passage of the contents of the gut after enemata had been administered; yet no one suffered either from cholera or diarrhœa; neither did the washerwomen suffer, although they washed the clothing and bedding on which the patients had lain, which were commonly saturated with the rice-water motions. We must conclude, therefore, that cholera is not communicable, but that it requires the media of bad air, bad living, filth, and wretchedness, through which to strike its victim."(c)

"I have no reason from what I have seen to consider cholera as contagious. There must have been nearly 300 persons living within the walls of the hospital at the time it

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(a) Dr. Millar, Royal Marines, Stonehouse.
(b) Mr. Kay, Assistant-Surgeon R.M.
(c) Dr. Rae, Plymouth.

prevailed, yet no one showed any symptom of the disease. At the same time, it appears more than probable that, like some other diseases, it may, under certain influences, become communicable from one person to another."(a)

"So far as my observations go, they incline me to think it most probable that cholera is propagated by contagion." "I think it is highly probable it has spread from India over the world by contagion."(b)

"That something superadded to the causes just mentioned, (filth, bad drainage, bad ventilation,) and which re-acting on them in some unknown way, produces the series of morbid phenomena which is expressed by the term cholera, it is as impossible to deny as it is to deny the existence of cholera itself; but what that something is, whether a chemical product, a modification of atmospheric electricity, a telluric emanation, or a microscopic sporule, or none of them, is a question which yet remains to be decided."(c)

"With regard to infection I am inclined to the opinion that the disease is neither infectious nor contagious."(d)

"A consideration of the circumstances which attended the outbreak, course, and decline of the disease, have led to an opinion that the poisonous agent is contained in the atmosphere. Persons of credibility observed a peculiar unpleasant odour pervading a narrow tract of the atmosphere, and perceptible only for a short time, an assertion which, if corroborated, would add an important testimony to its atmospheric nature."(e)

"Contagion or infection is not borne out by observation in this department, one nurse or attendant only having been attacked; and this man lived all the time on board the hulk where the disease first showed itself." "From the general spread of the disease over the kingdom, I am inclined to

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(a) Deputy-Inspector Drummond, Melville Hospital.

(b) A. Muirhead, Esq., Surgeon H.M.S. Ganges.

(c) Dr. Evans, Deputy-Inspector, Woolwich.

(d) P. Suther, Esq., Surgeon, Chatham Dockyard.

(e) Mr F. Noot, Assistant-Surgeon R.N.

believe it is essentially endemial, but aggravated in certain places from local causes, such as bad sewerage." (a)

"That cholera is epidemic, there can be no doubt, and that the general prevalence of the disease is much increased and aggravated by local causes there can be as little." "Now that the epidemic has disappeared, I feel more and more satisfied that my first impression was the correct one. Cholera is not contagious, but depends on some peculiar atmospheric condition not yet ascertained." (b)

"Of the existence of an atmospheric poison as the exciting cause, and of its maintenance and aggravation under the individual or collective influences which are admitted to have a tendency to vitiate the atmosphere, such as effluvia, gases, vapours, or exhalations from stagnant deposits, confined and filthy habitations, &c., I have not a shadow of a doubt. Of its non-contagious character, I have as little doubt." (c)

"The greatest liability to cholera, and its greatest mortality, were coincident with a stagnation of the lower stratum of atmosphere, and a diminished evaporation while the temperature was high and the ranges great. My conviction is, that cholera, under favouring circumstances, may be communicated." (d)

"I have no doubt in my own mind, from what I have previously witnessed, that Asiatic cholera, as it prevails in this country, is a truly contagious disease, and that atmospheric influence has little to do in its production, although it may in its extension." (e)

In the majority of these opinions there is little that is new; generally speaking, the reasoning amounts to this,—namely, that there was an epidemic, and because there was an epidemic there must have been an epidemic cause. Whence that originated, of what it consisted, how it acted, was per-

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(a) Dr. Webber, Convict Cholera Hospital, Portsmouth.
(b) Dr. Beith, Assistant-Surgeon, Greenwich Hospital.
(c) J. M'Ternan, Esq., Surgeon, Greenwich Hospital.
(d) Dr. Bruce, Deptford Dock-yard.
(e) Dr. Anderson, Sheerness Dock-yard.

petuated for brief but indefinite periods; how it advanced by stages from one part of the country to another—declining here and progressing there—whilst it harmlessly passed by intermediate places, has nowhere yet been satisfactorily explained. Admitting, for the moment, that there did exist some efficient aërial, or earthy principle in the atmosphere, capable of producing the disease, has its successive evolution at all times and in different places within the last forty years, from India to Europe in the first instance, and subsequently in this country and in America, been so generally in accordance with the laws of atmospheric diffusion as to afford any reasonable proof in support of the assumption? Most certainly it has not. The disease has extended as frequently against the wind as in the direction in which it was blowing. This could not have happened had the poison or cause been of the nature of a material agent generally diffused throughout the atmosphere, and subject to the ordinary laws of matter. Instead of breaking out and infesting particular spots, or lines of dwellings for three or four weeks in succession, and then passing onwards to others, a vast preponderance of cases of nearly contemporaneous evolution must necessarily have occurred, particularly in populous districts, where the physical and moral conditions of the people were the same, in lines corresponding and continuous with those over which the supposed poisoned wind had swept in a steady current; it might be for days or even weeks without ceasing. If, indeed, the essential cause of cholera be contained in the atmosphere, it would appear, that on the great scale, that is, as regards its general diffusion over a country, it is uninfluenced by the motions of the atmosphere; and, if we may judge by the slow progress of the disease from one country to another, and by its successive stage-like developments, it can no more be wafted about on the surface of the earth than the forces of magnetism and gravitation. On these premises, then, it may be safely assumed that the excitant cause of cholera is not engendered in the air, nor does it exist in it in the form of any miasm, effluvium, or gas, physically resembling any product of the soil with which we are acquainted. If in reality there be any such condition

as an epidemic constitution of the atmosphere, it evidently must depend on local emanations; but, as to whether these are of a personal or a terrestrial character, is a question that need not at present be entered upon.

With respect to the state of the weather, and the periodical changes of the seasons in the various districts over which the disease spread, as it does not appear that in these phenomena there was any great deviation or difference observed from what has been common to other years marked by a high standard of health, we can hardly suppose that they had any influence either in the production or the propagation of cholera. While damp, hazy weather preceded it in one locality, dry bracing weather preceded it in another; in a third it was ushered in with heat, in a fourth with cold, in a fifth with an east wind, and in a sixth with a west. We might suppose that it had progressed in its erratic course, seeking out its peculiar victims in particular places, uninfluenced by wind or weather, climate or season. Neither do the more laboured results obtained from instrumental observation, afford us the slightest grounds for supposing it was in any way connected with meteoric agency, whether as regards its origin or progress. The relative weight, moisture, and, so far as has been ascertained, chemical constituents of the atmosphere, were everywhere the same, or, at all events, nearly the same, as they had been through a continuance of years, when the disease did not exist. But, even although they had not been the same, any observable difference in either of these particulars would not help us to explain why the difference —defect or surplus—should act as an efficient excitant of the disease on one side of the Thames, and not on the other; why the inhabitants on one side of a street should be more than decimated, while those on the other side entirely escaped, both being equally exposed to the influence of the same atmospheric agencies.

The same remarks apply to electricity; for, whether it be quiescent or disturbed, whether stealing silently from cloud to cloud, or bursting through the air with explosive violence, we are not aware that it has the slightest influence on the

human constitution; unless, indeed, when man places himself in the path of its destructive discharge. In its latent state, or even when disturbed by natural causes, the experience of ages has not furnished us with a single well-established fact on which to found any one of the vague, unmeaning speculations which have been advanced respecting its influence on health. It is, therefore, imperative that we altogether set aside electricity, as an agent wholly inoperative in the causation or propagation of cholera.

The facts noticed respecting the influence of local causes in favouring the evolution of the disease, but more especially when viewed in connection with similar facts elsewhere adduced, as bearing on the same question, are so clear and conclusive, that it would, indeed, be difficult to believe that they have not been the means of forcing it into existence in places which might have escaped, had they been in a different condition,—that is, if they had been cleaner, more free from putrid or offensive effluvia, drier, and better ventilated. At Woolwich, the convicts were first attacked in a hulk which lay close to the opening by which a large covered drain discharged its fetid contents into the Thames; and, what is more remarkable even, the first attacks, and by far the greater majority of those that followed, occurred amongst the prisoners berthed on the side of the hulk next to the drain. A solitary case occurred in the tender to the *Ocean*, which, for a short time, lay in a somewhat similar situation with respect to the mouth of the principal sewer at Sheerness. "At Chatham, a gentleman, whose health was good, although not robust, and who resided in a clean, healthy locality, had occasion, during the prevalence of the epidemic, to superintend the cleansing out of a stagnant ditch at a considerable distance from his house. Whilst so engaged, he complained of an almost intolerable stench, arising from the filth, and feeling himself uncomfortable, he returned home. At his usual hour he retired to bed, apparently in good health. At three o'clock next morning he awoke in a state of collapse, and died nine hours afterwards." At Greenwich Hospital, a drain in which filth had been accumulating for many years was opened, when there suddenly arose from its contents an

overwhelming stench, which was instantly followed by a most destructive eruption of the disease ; the mortality in that part of the hospital nearest the drain being greater than in others more distant. Still, as the same drain had for years previously poured its filth into the Thames alongside the convict hulk at Woolwich,—as vessels had frequently before been moored off the great sewer at Sheerness, and as men of every grade and condition in life have been exposed to the most offensive and unwholesome effluvia, both at Chatham and Greenwich, without being attacked by cholera, —it becomes clearly evident that some other cause, besides the exposure to offensive effluvia, must have been in operation to produce the disease at the particular periods in these several places.

"The epidemic poison appears to travel in streams or currents." This seeming peculiarity may be accounted for thus:—First, as regards a country; men, if not generally, frequently live and follow their avocations in narrow tracts, such as along the banks of rivers, in valleys, and by roadsides; and secondly, as regards towns, in streets and lanes. In both these sites, as well from geographical position as from other causes, there are generally accumulations of filth; and if, as is frequently the case, they are situated at low levels, a damp, polluted atmosphere destructive of health, and tending to predispose the inhabitants to be attacked by any prevailing epidemic. Whether cholera be or be not infectious, these circumstances are deemed sufficient to account for the apparent extension or distribution of the exciting poison in streams or currents.

It is observed, that "as from experience we know the effects resulting from the exposure to the malarious atmosphere of the swamps of Africa and of the Pontine marshes, therefore we seek for similar causes to explain the origin of cholera." This, it is well-reasoned, should be received with caution. Remittent and intermittent fevers, depending on malaria, do not occur far from the jungles and marshes which yield these peculiar emanations; the cause of cholera, on the contrary, when once it has acquired epidemic force, extends far from the source of its evolution. Are we then to

suppose it is a product of the earth—the result of some physical change? That at certain times, and from unknown causes, there is let loose a specific miasm, which is wafted thousands of miles away from its source; riding—if the expression may be used—on the blast, and retaining without diminution of force its destructive properties for months and years after it has been evolved? Or are we to suppose that this agent is liberated from the soil at different, but yet not very distant, points, extending in lines across a country, as if the earth itself were diseased, and had its lazar spots, out of which issued a lethal product of the malady, inimical to man, and to man only? Fairly examined, neither of these propositions (although involved in the theory of an epidemic cause) can stand against others less extravagantly conceived. For instance: we cannot imagine, or suppose, that in 1817 there issued from the grand foyer at Jessore a poison which, dividing into continuous streams, passed over India, Europe, and America. Neither is it possible to conceive that the soil should cease to give out the poison at the spot where it first issued, but continue to send it forth at short intervals for several successive years, not generally over the surface of the earth, but here and there at points sometimes distant, sometimes contiguous, yet never at any great distance from the principal channels of intercommunication between towns, tribes, and nations; at least, we know of no similar agent, influence, or law in nature which can be adduced in support of an hypothesis so formed. If the same mode of reasoning be applied exclusively to the atmosphere, we are equally at a loss to comprehend how a distempered portion of it could extend to so great a distance without being dispersed and lost amidst the ever-varying currents by which it is disturbed. That the exciting cause of cholera is either so produced or disseminated is clearly at variance with all the known laws of chemistry and pneumatics. God! if it be admissible so to speak, has mercifully ordained, that neither the sea nor the air shall become corrupt. In each there are inherent powers of elimination which speedily remove from them all abnormal or obnoxious impurities. The foul

effluvia and smoke thrown into the one from the vast crater of London, and the horrid stream of liquid filth drained away from its base by the Thames into the other, are not traceable in either ocean beyond a few miles from their respective sources. The theory of a distempered condition of the atmosphere, depending on natural causes, would, therefore, appear to be utterly untenable. Considering the extent of space it occupies exterior to the earth; the varied and dissimilar nature of the earth's surface over which it sweeps; the incessant changes it undergoes in relation to its specific weight, by the influence of heat,—considering how it is disturbed by storms and currents, washed by the frequent descent of rains and vapours,—we need hardly, it is assumed, seek for other arguments to demonstrate the improbability, if not the impossibility, of a disease being induced by the presence of a morbific agent extending in streams over regions so widely separated as India, Europe, and America; unless, as hereafter to be noticed, it be maintained by local reproduction.

The only other theory at present to be noticed, is that which attributes the disease to a cause evolved from the soil or subsoil in the places where it has shown itself. This theory, founded apparently on the supposed spontaneous evolution of cholera in localities at short distances from each other, has the merit of being specific, although it hardly comes within the range of legitimate deduction; nor is it supported inferentially by the existence of any known agent or cause of a like nature. We (at least so it is assumed) are ignorant of any law or influence connected with the material world, which, in the natural course of events, could impart to small circumscribed spots, or to narrow tracts on the surface of the earth, at distant periods, and for brief portions of time, the property of emitting a peculiar morbific agent, capable of producing one series of morbid actions on one class of animated beings only. The ubiquitous agency of electricity and magnetism can have nothing to do with so mysterious a power as this; neither would they assist us in detecting its presence or its modes of acting. We might, by a stretch of the imagination, suppose this morbific entity to

be a new agent; but then it would become a question, whether, from the many distant scattered eruptions of cholera, and the supposed influence of the weather, both as regards its evolution and decline, it would not be more reasonable to assume, that, instead of rising from the soil or subsoil, it fell from the clouds, passed,—as, indeed, it has been suggested,—over a limited extent of the earth's surface, and then rose again into the upper regions, from which, like an unbroken cohesive cloud, it again fell to the ground; thus continuing, by its wave-like progression, to produce a concatenated string of effects across an indefinite tract of the globe. That there may be things existing in nature, which, as yet, have escaped our notice, and that amongst them there may be some co-operating cause or influence which issues from the soil, and assists in the propagation of epidemic diseases, it would perhaps be unreasonable to deny; but, as regards cholera, it is to be hoped we are now in possession of such facts as will enable us to explain its epidemic spread by an agency of a less problematical character.

It has been somewhat hastily concluded, that if cholera were truly an infectious disease, that the whole or the greater part of the inhabitants of towns would be swept away by it. It might as well be argued that the same result would follow an outbreak of other infectious diseases—as for instance yellow fever, or the general diffusion of a non-personal epidemic cause throughout the atmosphere, that if the wind once became charged with the poison, it would be suddenly scattered far and wide over a large extent of country, not dropping as has been supposed, and as the appearance of the disease might lead us to infer, on one town or village, and passing over others, or on certain districts of a town, while it left others unscathed. The very circumstance of cholera infecting particular localities, becoming, as it has been termed, "localised," most distinctly shows that it does not depend on what has been hitherto understood and described as an "epidemic constitution of the atmosphere." It is about as impossible to imagine that the wind which passed over a small village in Argyleshire, was impregnated with the choleraic miasm, and that

the parallel currents on each side of the village were free from it, as it is to imagine that the toll-bar beyond which the disease did not extend formed an obstruction to its progress. (a) In all communities there are some persons more liable to be attacked by any prevailing epidemic than others; the latter fortunately, or by a wise provision of nature, are generally the more numerous. Nevertheless, if all the morbid affections arising from the choleraic cause were properly stated,—that is, if all the cases of cramp, diarrhœa, and disordered bowels, had been enumerated under the same head with cholera, it would be found that the proportion of residents in those towns in which it acquired any great degree of virulence, who entirely escaped its influence, was much smaller than is generally believed. In estimating the number of cases of influenza that occur in any given locality during an epidemic invasion of that disease, we do not usually separate those which present merely catarrhal symptoms from the more severe, which seriously involve the bronchial tissues; by the same rule the surplus of diarrhœal cases which occur during an epidemic invasion of cholera should be included under that head.

During the year 1849, after deducting the proportion of deaths from diarrhœa common to years when cholera did not prevail, there occurred about 15,500 deaths from cholera and diarrhœa in the metropolis. By admitting (and it is presumed the estimate is within the mark), that for each of these deaths there were, including cases of diarrhœa and other allied affections occurring from the same cause, at least twelve recoveries; this would give 186,000 as the total amount of attacks; these again, multiplied by twelve, would give 2,232,000,—a sum equal to the entire population of Lon-

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(a) "In Darvel, a small village in Ayrshire, which had escaped the epidemic of 1832, cholera broke out in January last (1849), but confined itself completely to one-half of the town, although it consisted only of one main street, which is divided into two nearly equal parts by a toll-bar, beyond which to the west not one case occurred, although the inhabitants were in constant communication with those of the infected locality, and to all appearance under much the same physical circumstances."—*Dr. Beith's Report.*

don; showing that, even including the more healthy districts, every twelfth person suffered more or less from the prevailing cause. If the more healthy districts were struck out, and the calculations made on the returns from those only that suffered most, it might be shown that in those, making a fair allowance for cases which attracted little or no attention, there were few of the inhabitants who entirely escaped the prevailing disease in one form or other. It is, therefore, evident that, although the disease may rage with great virulence, and although it may be highly infectious, still there is no reason to conclude that it ought to sweep away anything like the greater bulk of the population.

As it is not possible then, from all that is known respecting the qualities and motions of aërial bodies, to ascribe epidemic cholera to an abnormal condition of the atmosphere, whether that condition results from physical changes in its natural constituents, from simple admixture with miasmata, or with other unknown telluric emanations, having the properties of matter, are there any good grounds for supposing that it results from a specific animal poison emanating from the human frame? By comparing its evolution and spread with the evolution and spread of other infectious epidemics, the similarity of all [the principal phenomena will, to say the least of it, appear sufficiently remarkable.

For example: in the year 1835, several cases of small-pox were introduced into the island of St. Mary, which lies in the estuary of the Gambia, where the natives, not being protected by vaccination, are necessarily, with respect to their susceptibility of small-pox, on the same footing with the people of this country as regards cholera. These cases were placed in a detached building, surrounded by a high wall, and at a considerable distance from the town; and all communication between them and the people of the town was strictly interdicted. Here the disease entirely wore itself out, and there was no suspicion that it had extended further. In the course of two or three weeks however, a case made its appearance in a hut at the opposite extreme of the town, nearly a mile distant. Other cases followed in the

adjoining huts, and soon afterwards the disease spread all over the town. In about a month afterwards, it next appeared in a village a few miles further up the river, with which there had been frequent intercommunication by canoes. After it had become fairly established ("localised?") in this village, it next, after similar periods of delay, successively extended to others still further inland, while nearly all the villages in the creeks, and on the tributaries of the main stream, became involved; some, as happens in cholera, escaping for a time, but suffering subsequently when the disease had declined in those around them, whilst others escaped altogether. Still the epidemic, on the great scale, went on spreading by stages far and wide over an immense extent of country, until every trace of it was finally lost amidst the tribes of the interior, with which there is no communication.

Difficult as it may be to account for an eruption of cholera and its subsequent extension in places having but little communication with each other, it most unquestionably appears, not only in this country, but over the whole of Europe, to have been governed by laws, if not identical, at least somewhat similar to those which governed the spread of small-pox as detailed in the preceding instance. And if in that case the epidemic cause was not successively evolved from the soil, or from the atmosphere, at the different times and places where the disease made its appearance, as most unquestionably it was not, there is as little reason to suppose that the cholera during its first or last invasion of this country arose from a peculiar condition of the earth or the air, at the different places in which it made its appearance. If, indeed, we must have an epidemic cause affecting particular places, and endowed with specific properties, attacking the population on one side of the Thames, while it leaves untouched those on the opposite side, it is surely more reasonable, and more in accordance with established facts, to suppose that it originates from a diseased condition of mankind, rather than from a diseased condition of the air they are breathing, or of the earth on which they tread.

It is very difficult to obtain any direct or positive proof of

the infectious communication of cholera, in consequence of the evidence required to establish the fact being generally complicated with evidence in favour of other presumed causes, or rather, perhaps, from the difficulty of proving that there did not exist some local cause capable in itself of producing the disease. For instance; a ship of war in which there had not been any cases of cholera, came in from the open sea, and anchored at Spithead. Two men left her, and took up their abode with their friends in a dirty lane in Portsmouth, in which cholera was prevalent; they immediately contracted the disease, and died of it. This, by one class of reasoners, is set down as direct proof of infectious communication; by another class, that it only proves the existence of the same epidemic cause which produced the first cases in the locality, while the disease was still too far distant to attribute them to a personal virus. It thus becomes evident that we cannot arrive at any satisfactory conclusion from facts so complicated and so liable to be turned in favour of either side of the question. If these men, after contracting the disease in the lane, had, while it was yet in its incubative stage, returned on board, and there suffered from it; then, if the disease immediately afterwards had spread among others of the crew who had not had communication with the shore, the conclusion most unquestionably would have been that it was infectious.

On the other hand, the proofs adduced in support of infectious propagation are not numerous, and there are few of them against which serious objections might not be raised by those who take an opposite view of the question; while there are others,—such as the appearance of the disease at Noss after the arrival of the fishing vessel from Dieppe, and the seizure of the attendant on the tramper in Chatham Workhouse, which it would be difficult to deny, although the eruption of the disease in both these instances so soon after exposure to a presumed infectious source, might no doubt be set down as merely coincidental; still, so frequently has it happened that these so-called coincidental eruptions of cholera have followed the introduction of one or more cases into a healthy locality, that it will be very

difficult to explain them all by any rule or law appertaining to the doctrines of chance.

Mr. Greene, of Fraserburgh, gives the following account of the introduction of cholera into two villages in Scotland:—"Two boats, one belonging to Cairnbulgh and the other to Inveralochy, met at Montrose, and their crews on several occasions strolled through the town in company, although aware that it was at that time infected by cholera. On their passage homeward, they were obliged to put into Gourdon, where one man belonging to the Cairnbulgh boat died on the 22nd of September, after an illness of fourteen hours, with all the symptoms of cholera. Several of the men of both boats were at the same time attacked with serous diarrhœa, of which three of them had not recovered when they reached their respective homes; nor indeed until the first cases of the epidemic broke out in the villages."

In Inveralochy the first case appeared on the 28th of September, three or four days after the arrival of the boat; the sufferer, the father of one of the crew, had been engaged in removing the cargo along with other members of his family. Two other cases occurred in this family, one on the 30th of September, and one on the 1st of October.

In Cairnbulgh, the first cases appeared on the 29th and 30th of September respectively, and both patients had also been engaged in removing the cargo of the boat (shell-fish) belonging to that village. No other cases appeared until the 3rd of October; so that from the 28th of September to the 3rd of October none were attacked in either village, but those who had come in contact with the suspected boats, or their crews.

The subsequent cases were chiefly among relatives of those first attacked; and the order of their propagation was as follows:—"In Inveralochy, the first case was the father of a family; the second, his wife; the third, a daughter living with her parents; the fourth, a daughter who was married and lived in a different house, but who had attended her father and mother during their illness; the fifth, the husband of the latter; and the sixth his mother. Other cases occurred at the same time, although they were not known

to have communicated with the former. One of them was the father of a family; the second his son who was seized the day after his father, and a daughter the next day."

The first cases at Boddam are thus detailed by Dr. Jamieson, of Peterhead(a) :—"A married woman, of sober, industrious habits, who had not, as far as was known, been exposed in any infected locality, was, when returning from one of her usual journeys, attacked with diarrhœa. After reaching home she partook of the usual family meal, and, without complaining, retired to bed. Early on the following morning she was awakened by severe cramps, which speedily terminated in collapse and death. This woman's son, who had attended her during her illness, was the next person attacked, after which the disease spread rapidly in the village; but the attacks were almost exclusively confined to near relations of the first case, who had been exposed to infection while attending on their sick friends." It is also possible, that in these three villages the eruption of the disease may have occurred coincidently with its introduction; but, considering how rigidly the whole of the first attacks were confined to those who came most in contact with the imported cases, it is far from being probable.

There were circumstances attending the eruption and progress of the disease in the ship *Havering*, which have been already noticed, and in the *Apollo*, hereafter to be mentioned, that, however, do not admit of these evasive modes of reasoning; and, if fairly examined on their own merits, and in connection with other infectious epidemics, it is presumed they will go far to settle the question, as to whether cholera, as it has generally occurred in this country, depends on an epidemic constitution of the atmosphere, or on a personal virus emanating from the bodies of the sick; for, if it can be once established that a series of cases have occurred, as they most unquestionably did in these vessels, in a manner which precludes the possibility of attributing them to any other cause than infection, it will be in vain to deny, that

(a) For these interesting communications we are indebted to Dr. Bruce, of Deptford Dockyard.

because the disease in every instance and on all occasions has not spread, that it is not infectious. With as much reason we might contend, that because every spore of the common puff-ball fungus that is scattered on the ground does not germinate and grow, that they are not the means by which the plant is reproduced and propagated.

The Havering having been chartered by order of the Right Honourable the Lords Commissioners of the Admiralty to convey prisoners to Van Diemen's Land, left Deptford on the 21st of June, 1849. She had then on board a guard consisting of fifty soldiers, and a crew of sixty seamen. The former came from Chatham, and the latter, it is to be presumed, were entered on board in the usual way, and came from places in the immediate neighbourhood of the docks. It is immaterial for the present whether cholera existed at the time in either of these places, as the proofs of its having displayed infectious properties rest principally on the subsequent progress of the disease.

On the 20th of June, when she was off the Start Point on her way down Channel, and at a considerable distance from the land, cholera suddenly made its appearance, first among the soldiers, and then, two days later, (on the 28th,) among the seamen. In attempting to trace the disease to its source in this vessel it will, it is assumed, be necessary to adopt one of the following theories respecting its origin, viz. :—1. That both classes of men had been separately exposed to the influence of an epidemic cause previously to their joining the ship; or that, conjointly, they had been exposed to the same influence after they had embarked somewhere in the river, or after the vessel had entered the English Channel; or, 2ndly, that a choleraic cause, not depending on extraneous sources, had been generated or evolved within the ship, or that she had acquired it by passing through a distempered portion or current of the atmosphere; or, 3rdly, that the soldier who was first attacked had brought with him the germs of the disease, which were, subsequently, developed, after a period of incubation, and afterwards reproduced, and propagated through a succession of cases, until every person within the vessel exposed to their influence and susceptible of the disease had been attacked.

There are several reasons why the first and second of these views or theories should be rejected. In the first place, because few if any of the numerous vessels entering men at the same time and from the same places exhibited anything like the same proportion of cases; by far the greater number entirely escaped, a fact of itself which goes far to prove that the disease, at least as regards the majority of the attacks, did not originate from any general cause exterior to the vessel. Moreover, if the men had contracted the disease on shore, it is extremely improbable that its evolution would have been retarded for so many days, or that the attacks, when they did occur, would have been so simultaneous; and further, because after the disease was evolved, the proportional number of attacks within a given space of time, as well as the proportion of attacks to the number of persons, was widely different from that which occurred amongst the communities which they had just left. Of the hundred and ten men on board the Havering, twenty-eight were attacked with cholera and diarrhœa within the space of eleven days. Had the inhabitants of the Eastern district of London suffered in the same proportion, those who escaped would hardly have sufficed to attend to the ordinary wants of the sick, and to bury the dead.(a) Lastly, as the ship was new and thoroughly clean in all her compartments, it is equally improbable that any cause could have been generated in her, either among her stores or in her holds, and not in any other vessel, however differently freighted, passing between the estuary of the river and London-bridge. As it is not possible, then, for these and other reasons, to attribute the whole of the attacks to the individual exposure of the soldiers and seamen to an inorganic poison generally diffused in the atmosphere, or to any local poison arising from the timbers of the ship or from her cargo, or to her having passed through a column of poisoned air on her way

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(a) One in every 4 of the 120 men in the Havering was attacked, and one in every 18 died. Had the attacks and deaths in the Eastern district been the same. the population (according to Table No. 3 in the Report on Epidemic Cholera, published by the Board of Health), being 445,859, the attacks in eleven days would have amounted to 111,464 and the deaths to 24,769!

to the Start Point, setting aside all problematical and purely supposititious causes, we are inevitably forced to the conclusion, that the whole of the attacks subsequently to the first must have been the result of a specific infectious virus, emanating from the person or the persons previously affected. It is at all events more probable, and more in accordance with reason and analogy, to suppose the disease was so introduced and propagated, than to suppose that each succeeding case that occurred was the result of a non-personal cause, generated either within the ship herself, or in the earth, in the air, or in the water immediately contiguous to the ship. The whole of the circumstances attending the eruption, extension, and decline of cholera in this vessel, so strikingly resemble those which usually attend the invasion of other infectious maladies, that were the name of the disease withheld, and the circumstances only described, it would be difficult to decide whether the crew had suffered from typhus fever, yellow fever, or cholera.

The following is another instance of the propagation of cholera from one or more cases transported from an infected locality into a healthy ship, which can only be explained by the reproduction of an infectious virus through a series of consecutive cases. Her Majesty's Ship Apollo, employed in the conveyance of troops, left Spithead on the 4th of June, 1849, and arrived at the Cove of Cork on the 7th. On the 11th of the same month, 513 men, 43 women, and 40 children, all of or belonging to the 59th Regiment, were embarked for a passage to Hong-Kong, and on the 17th she sailed for her destination. It may be as well to state that cases of cholera had occurred, if not in the regiment, at least in the barracks from which it came, a short time previous to its leaving them, and that the disease was also prevalent in the neighbourhood. On the morning of the 18th, the day after she left the Cove of Cork, a case presenting in the onset symptoms of the worst character occurred, and in the course of a few hours terminated fatally. As no case had occurred previously in the ship, there is every reason to suppose that the germs of the disease in this instance were contracted on shore. No other case, presenting any of the well-marked

symptoms of cholera occurred, until the 26th, when one of the women was attacked;—she recovered. On the 29th the third case occurred, and proved fatal to the patient, a soldier, within the space of a few hours. It is also possible, although (particularly with regard to the last one) not at all probable, that both these cases may have been contracted before the parties joined the ship, but those which occurred subsequently to this date, considering the lapse of time and the nature of the atmosphere the ship had passed through, can no longer be attributed to the influence of local causes, whether of a terrestrial or personal nature, operating on the men severally before the ship left Cork. Whatever may have been the cause or causes, it is now evident we must look for them within the ship herself.

On the 29th she reached Madeira, but not being allowed to communicate with the island, otherwise than by the pratique boat, she merely hove to for a short time in Funchal Bay, and then proceeded on her voyage.

On the 1st of July, she anchored off Santa Cruz, Teneriffe; pratique was refused here also, but provisions were permitted to be brought on board. On the following day, the 2nd of July, a fortnight from the time she left Cork, the next case occurred; then there was one on the 5th, one on the 7th, one on the 8th, one on the 9th, and one on the 10th. All these recovered; but there was one on the 16th and one on the 18th, both fatal. On the 19th, from causes to be presently noticed, there was a sudden aggravation of the disease, and now, thirty-two days after the vessel's departure from Cork, it began to extend to the ship's company, which had hitherto entirely escaped. Of the six cases which occurred on the above date, three of the patients belonged to the ship, and three to the regiment; two of the former and two of the latter proved fatal. On the 20th, there were three cases,—one soldier and two of the crew; the latter both fatal. On the 21st there were two cases, on the 22nd one, on the 23rd two; all these recovered. Again, on the 29th there were two, and on the 30th two—all four fatal. On the 30th there was one, which recovered. On the 5th of August there was one, and on the 11th another, the last that presented un-

equivocal symptoms of cholera ; both these cases ended fatally.

When the vessel left Teneriffe is not stated, but she crossed the equator on the 24th of July, and arrived at Rio de Janeiro on the 7th of August. As the Brazilian authorities would not permit the sick to be landed, nor the vessel to be cleared out within the harbour, or at any of the contiguous islands, she sailed on the 10th for the Ilha Grande, which lies about sixty miles to the westward of Rio, and on the 12th anchored in Albroo-bay, which was selected as being a convenient place for clearing her out. On the 13th all the troops and the sick, the latter seventy-two in number, were disembarked ; the former were placed under canvass, and the sick in a cottage fitted up as a temporary hospital.

No new cases occurred amongst the crew after the 23rd of July, the day before they crossed the equator; but cases continued to occur amongst the troops at various intervals of time, up to the 11th of August, two days before they landed. The last case was of a very decided character, proving fatal in eight hours. Still, although there were no more cases presenting the peculiar characteristics of cholera, there were many diarrhœal attacks. From the time the disease broke out, in fact until after they had been several days landed on the island, diarrhœal complaints were numerous, and in some instances so severe that it was difficult to decide under what category they ought to be placed. The total number of decided cases of cholera amounted to thirty-two, of which sixteen recovered and sixteen died.

The medical officer in charge of the troops and the medical officer of the vessel gave the following opinions respecting the origin and the persistence of the disease :—

" Considering the circumstance of the disease having made its appearance so shortly after the embarkation of the troops, its having existed among them so very recently before their embarkation, and their having been embarked directly from a barrack in which, as we are led to believe, cholera prevailed, we are of opinion that the disease did not

originate in the ship, but that in consequence of the crowded state of the troops and the imperfect ventilation, (notwithstanding the adoption of every possible available means for that purpose,) an atmosphere has been generated on board favourable to the development of such disease in those previously exposed to the poisonous influence causing it, (as the troops had been before, and at the time of embarkation,) if not also to its spread among others, whose constitutions may have been originally more than usually susceptible to any morbific influence, or have been rendered so by the debilitating effects of such exposure as necessarily attends their position on board ship.

"In arriving at this conclusion we are further influenced by the fact, that the ship's company remained free from the disease for a considerable period after its appearance among the troops, and even then not until the existence of atmospheric conditions peculiarly favourable to its spread, namely, close damp weather; and also by the unusual circumstance of the disease for some time increasing as we proceeded to sea, and still continuing, instead of, as we had every reason to expect, its gradually disappearing by our more distant removal from the neighbourhood in which the disease seems to have been contracted."

Whether the exposure of the soldiers to the exciting cause of the disease at Cork had any effect in favouring the production or development of the cases which occurred after the ship had entered the tropics, it would be difficult to determine, because we have no experience or knowledge of any similar facts to guide us in reasoning as to the probability of such a result; but, as the seamen who were not so exposed at Cork suffered nearly in the same ratio with the soldiers upwards of thirty days after they had left the land, the probability is, that it had no effect whatever; and, as the accommodations in the ship were the same as they had been before, when cholera did not exist on board, and as they were not dissimilar to those in other vessels of the same class similarly employed, there is about as little reason to suppose that the exposure or position of the seamen at the present time induced debility, or otherwise rendered them unusually

susceptible to any morbific influence. How far a poisonous atmosphere,—or, rather, a poisonous condition of the atmosphere, from admixture with personal emanations,—generated on board, was wholly and solely effective in the production of the cases subsequently to the first three or four, remains to be seen.

As soon as the troops and the sick were landed, the seamen began to clear out the holds, which were found to be clean, and dry, and free from offensive effluvia. Every other part of the ship was examined, but nothing whatever was discovered that could, either directly or indirectly, be supposed to have been instrumental in the production of the disease; and as the seamen, while thus employed, did not suffer from any choleraic symptoms, it will be necessary to examine what the proofs are in favour of its having been the direct result of a personal cause, introduced and propagated among her living cargo.

The ship's company occupied the starboard side of the main or uppermost covered deck; the troops, part of the opposite side of the same deck, and the whole of the lower, or the deck immediately underneath. Between this latter and the main deck there were four wide tubes, two on each side, for allowing the heated air to escape from the lower deck, but, as they were not carried on through the upper deck, as they ought to have been, they merely served to relieve the one deck of impure air at the expense of the other. These tubes, for some reason, or it may have been from accident, remained closed until within two days of the occurrence of the first cases among the ship's company; and, what is of still greater importance to observe, the greater number of the cases on this deck occurred among the men belonging to the messes close to the apertures of the tubes, or to the main hatchway, by which the impure air also escaped; distinctly showing one of two things,—namely, that the disease was either communicated from the people on the lower deck to those on the upper by a personal virus, or that the impure air from the lower deck so greatly impaired the health of the men breathing it, as to render them more susceptible to the influence of an unknown exciting cause hovering within or around the ship. But, as it is utterly physically impossible

that any aërial poison, or other cause connected with an epidemic constitution of the atmosphere, could have adhered to the vessel so long and so far across the ocean, the question as regards the true source of the disease becomes still further narrowed, and, at the risk of repetition, may be thus summarily stated :—Cholera made its appearance among the troops immediately after their removal from an infected locality into a healthy ship, the first case occurring the day after they went to sea; the second, a week later; and then dropping cases and cases of diarrhœa up to the 19th of July, thirty-two days after they had left the land, and about two thousand miles distant from the spot where it originated. Immediately after a free atmospheric communication had been opened up between the two decks, the disease began to attack the ship's company, those who were the most exposed being the first to suffer, although they had not had any direct communication with the original site of the disease at Cork, nor, for a period of at least six or seven weeks, with any other place besides the ship wherein it existed.

These latter cases occurring amongst the seamen thirty-two days after they had gone to sea cannot, it is confidently assumed, be attributed to any local telluric cause; nor is it possible to suppose they could be the result of an epidemic cause floating in the atmosphere and following the ship across the Atlantic; and, as it is equally improbable, considering the clean state of the hold, and the length of time the seamen had been living on board, that they originated from any cause (other than the emanations arising from the sick) within the ship, it is hardly possible to conceive that we shall ever obtain more conclusive evidence of the propagation of any disease by a specific infection arising from the human frame.

In the Appendix A (a) to the Report of the Board of Health on Epidemic Cholera, an opinion is expressed with respect to the danger of vessels with cholera on board going to sea, which, in justice to the naval service, it is necessary to take some notice of, as, if acted on in every instance, it may lead to the most serious consequences.

(a) Page 140.

Speaking of the emigrant ship American Eagle, Dr. Sutherland makes the following remarks :—

"A large vessel, which in an ordinary season might possibly have carried its crew and passengers across the Atlantic in safety, is laid in dock close to an epidemic locality. The stagnant water of the dock leaks into the vessel and becomes offensive; the ventilation is very defective; an overcrowded population of emigrants is placed on board; their food is unwholesome; and the personal habits of many of them filthy."

"Cholera strikes the ship just as I have seen it again and again strike a similarly circumstanced locality on shore."

"Had proper care been taken to preserve the neighbourhood of the docks in a proper sanitary state, we have every reason from experience to believe that an epidemic centre would not have existed there; and had the requisite precautions been taken on board the American Eagle, it is equally certain the crew and passengers would have escaped cholera."

"The case of the American Eagle further shows the importance of preventing the sailing of an emigrant ship, or any other vessel, when cholera has broken out on board. The greater purity of the air at sea, and the getting out of the epidemic atmosphere, which the ship by sailing might perhaps soon do, may appear at first view to be reasons for her putting to sea with all possible despatch. But this view is a fallacious one, and, if acted on, would involve the certain destruction of numerous persons."

"No matter how pure the atmosphere into which the ship may sail, this pure atmosphere cannot be got to the unhappy passengers. There is no possibility of substituting it for the poisoned atmosphere which is in the ship, which she carries with her, and which her overcrowded population continue to breathe.

"Under ordinary circumstances there was nothing (in the ship) that would have produced more than an ordinary amount of sickness, but quite enough, during an epidemic, to determine its localisation."

Now, what the results might have been had this vessel remained at sea, instead of running into Plymouth, can

only be a matter of conjecture; they might or they might not have been as Dr. Sutherland has predicted. But, in a ship of war, or even in the majority of merchantmen, although ventilation by windsails might be greatly neglected, it is hardly possible to imagine that a portion of infected air, abstracted as it were from an epidemic centre existing in the general atmosphere near a dock, could be confined within her, and retain its peculiar destructive properties for days, much less for weeks in succession. How long the essential cause, the true source of the disease, without which it could not exist, contained in so small a portion of the atmosphere as would occupy those portions of the ship in which the men live and move about might retain its morbific influence, after being separated from its centre, we need hardly ask, because it is evident that the air itself in which it was contained, would necessarily be displaced in the course of a few hours at most by the ordinary movements of the atmosphere, by the currents of air thrown down into the body of the ship by the sails, by the motions of the men themselves, and by a hundred other disturbing causes, which it is not necessary to mention. It is therefore obvious, that a disease depending on a cause thus accidentally introduced into a ship, would, in the course of a short time altogether cease, unless the cause continued to be re-produced within the ship after she had left the infected locality, and that the efficient cause of cholera has been thus produced in vessels situated similarly to the American Eagle, after leaving an epidemic centre, there can be no reasonable doubt; but it has not been produced by any peculiarity in the ship herself, or her cargo; neither has it arisen from a distempered condition of the atmosphere surrounding the ship, but from the diseased condition of the living beings contained within her. The most offensive dock-water that ever leaked into a ship, or the greatest accumulations of filth amongst men closely crowded together, have never been known of themselves to produce Asiatic cholera in this country.

The following short sketch of the eruption and decline of cholera in several vessels of war in the Mediterranean in 1850, will show how far Dr. Sutherland's views as to the

danger of a ship going to sea with the cholera on board are borne out by experience; for instance :—

Cholera was first recognised in its malignant form in the fleet, on the 15th of June; on that day one case occurred in H.M.S. Caledonia, while she lay in the grand harbour of Malta. This was followed by several other cases, and by cases of diarrhœa; she accordingly went to sea. On the 3rd of July a few more cases occurred, but, as she stood well off the land, the disease, in less than a week, entirely vanished. On the 30th she returned to Malta harbour, but went out again almost immediately. On the 4th of August the disease again made its appearance, but, as before, rapidly declined; no new cases occurring after the 14th. On the 2nd of September she once more entered that part of the harbour called Bighi-bay, to obtain water and stores, but remained only a day or two; for the third time the disease showed itself, and was not entirely got rid of until the 23rd of the month.

In the Queen, the disease broke out in the same harbour, on the 19th of June. On that day there was one case, which was followed, during the succeeding week, by a number of diarrhœal attacks; then there was another case of cholera on the 28th, three on the 29th, one on the 30th, two on the 1st of July, five on the 2nd, three on the 3rd; on the latter date the vessel went to sea. Subsequently, for twelve days, the daily number of cases of cholera and choleraic diarrhœa was as under :—

On the 4th	there were	3	cases of	cholera and	15 of diarrhœa.
5th	,,	1	,,	7	,,
6th	,,	1	,,	6	,,
7th	,,	0	,,	3	,,
8th	,,	0	,,	4	,,
9th	,,	0	,,	4	,,
10th	,,	1	,,	4	,,
11th	,,	2	,,	7	,,
12th	,,	1	,,	7	,,
13th	,,	1	,,	8	,,
14th	,,	0	,,	3	,,
15th	,,	0	,,	3	,,

After this, the vessel keeping at a considerable distance from the land, both diseases entirely disappeared.

On the 14th of August she ran into Bighi Bay to procure water, and, on the 16th, rejoined the squadron at sea, which immediately stood away to the north westward. On the 19th, three days after leaving the harbour, the disease again made its appearance. One case of cholera occurred on the 19th, and, on the 21st, there was another, and seven cases of choleraic diarrhœa; attacks of the latter kind continued for several days longer, when both diseases entirely disappeared. The ship, in the meantime, stood across to the coast of Sardinia, but returned "to her old cruising ground," off Malta light-house, on the 29th. On the 4th of September she entered Bighi Bay, and remained there until the morning of the 8th. Early on that day, while she was being towed out to sea, for the third time cholera broke out with fearful virulence, after "a lapse of seventeen days;" the greatest number of attacks occurring on the two days after her departure.

On the 8th there were	7	cases of cholera,	1	death, and	3	{ cases of diarrhœa.	
9th	„	15	„	6	„	9	„
10th	„	14	„	9	„	11	„
11th	„	1	„	3	„	15	„
12th	„	3	„	2	„	14	„
13th	„	2	„	1	„	9	„
14th	„	4	„	2	„	6	„
15th	„	4	„	2	„	3	„
16th	„	1	„	1	„	9	„
17th	„	1	„	3	„	11	„
18th	„	1	„	—	„	6	„
19th	„	—	„	1	„	9	„

After the 19th cholera entirely ceased in the Queen. She continued at sea until the 8th of October, when she anchored in Port Mahon, and did not return to Malta until the disease had ceased there also.

In the Bellerophon, the first case occurred while she lay at Malta, on the 26th of June, then on the 27th and 28th there were many cases of diarrhœa, and, on the 29th, two

cases of cholera. On the 2nd of July she went to sea: no new attacks occurred on this occasion, until the 8th, when there was one. On the 24th of July she anchored in Bighi Bay, but remained there only two days: no attack followed this visit. After cruising about in various directions, the crew having been in the enjoyment of the most perfect health for nearly two months, she returned to Malta harbour on the 9th of September. On that day, one case of rather a doubtful character occurred; but, on the 12th, there were four cases respecting which there could be no mistake, and, on the 13th, there were no fewer than thirty-one; still this did not prevent the vessel from going to sea. Subsequently, until the 19th, the daily number of attacks were as follow:—18, 8, 13, 8, 4, 2. After this, the vessel continuing on her homeward voyage, the disease became extinct.

In the Superb, the Ganges, and the Powerful, all line-of-battle ships, with their full complements of men, similar results took place. They contracted the disease in Malta harbour, but speedily got rid of it by going to sea. In the Frolic, of sixteen guns, a fearful outbreak of the disease took place on the 2nd of October in the same port. In two days she lost twelve men out of thirty-one attacked; still there appears to have been no hesitation in sending her to sea, where the disease almost immediately began to decline, and in the course of five or six days it entirely ceased.

Had these vessels not returned to Malta harbour, it might have been said, that on the first cruise all the men that were susceptible of the disease had been attacked, and, therefore, that it ceased not so much from their entering the purer atmosphere of the sea, as from a want of subjects with that particular kind of constitution on which the poison most readily takes effect.

The preceding facts, although many others of a similar nature, and equally conclusive as regards the results, might be adduced, are deemed sufficient to prove, that, so far as ships of war are concerned, it would be much more dangerous for them to remain in an infected port, with cholera on board, than to proceed to the open sea, where, far away

from a locality in which the atmosphere is poisoned by the emanations from a crowded population suffering from the disease in all its various forms, it will, under ordinary precautions, rapidly decline, and in a very short time become totally extinct, provided the men are in the enjoyment of their ordinary health. In emigrant vessels, however, and in vessels carrying troops, where the ventilation is generally much more defective, it may possibly linger longer, as it did in the Apollo. Under these circumstances, therefore, it might be as well to adopt, in some respects, the views of Dr. Sutherland; namely, to land the passengers and crew on some small island or point of land where there were no inhabitants, and at a distance of at least ten or fifteen miles from an "epidemic centre;" whether that be supposed to originate from the accumulation of a morbific influence issuing from the soil, or from the accumulation of an infectious poison emanating from a multitude of human beings labouring under the malady. Hulks are not well adapted for the treatment either of infectious or epidemic diseases; besides being cold, damp, and comfortless, they invariably float at a low level, in a humid atmosphere, in creeks or tidal rivers, the shores of which abound in malarial exhalations, detrimental to health, and peculiarly favourable, if not to the production, at least to the propagation of all epidemic maladies.

The extension of an infectious personal emanation to places eight, ten, or even twenty miles distant from its source, will, no doubt, be regarded as a most preposterous proposition; yet, in the absence of all proof respecting terrestrial, or other non-personal aerial causes, it seems to be not altogether unworthy of consideration.(a) In the admirable Report, recently presented to the public by the

(a) A philosopher observes, "If a virus can be transmitted from the body through a few feet of air, we are not entitled, from the partial experiments hitherto made, to set any limits to the extent to which, under favourable circumstances, it may be conveyed through the same or other medium. Common reason here concurs with our actual experience of the transmission of the virus of certain diseases in various ways and to remote distances."—*Dr. Holland's Medical Notes*, etc. P. 281.

Board of Health, it is stated, at page 40, that " in the space of twenty-four hours an adult person breathes thirty-six hogsheads of air ;" now, admitting that, during several days or weeks in September, 1848, there were occurring daily, in and around Hamburgh, 500 cases of confirmed cholera, and twenty times that number of milder cases, in the form of disordered bowels, diarrhœa, spasm, and other anomalous complaints, this would, at all events, give, as the product of 10,000 pairs of lungs, the enormous quantity of 360,000 hogsheads of infected air thrown into the local atmosphere daily, to say nothing of its being further contaminated by the emanations from the surface of the body, and from other natural and diseased excrementitious matters expelled from it. Let it, then, be supposed that the force of the wind was *nil*, or that its motion, in any direction, taking the mean of the changes, did not exceed a mile or two a day, we should thus have an atmosphere polluted to an extent far beyond what it is possible to imagine could occur from any corruption of its normal constituents, or from its being mixed with local emanations from the soil. How long a portion of the atmosphere so contaminated may remain unchanged, or to what distance it may be conveyed, there are no means of correctly ascertaining. It is not necessary to suppose that the disease was in this manner introduced into England, because, as will presently be shown, it may have been conveyed across the German Ocean in a different form. From the circumstance of cholera having appeared in several ships of the Mediterranean squadron before they had any communication with the shore, there is, however, reason to believe that an atmosphere, charged with the specific virus emanating from a population labouring under cholera and choleraic diarrhœa, may at all events prove effective at the distance of several miles from an infected locality, thus rendering legislation with regard to quarantine restrictions an extremely difficult question.

With respect to the conveyance of the specific poison in contact with inanimate substances, such as articles of clothing, the introduction of the disease into Malta, in 1837, as detailed by Sir John Liddell, Inspector of Hospitals at

Greenwich, affords a good example. He observes that, "during the early part of the above year cholera raged with great virulence in Sicily and Naples; consequently, vessels arriving at Malta from the latter port, were placed in strict quarantine. In the early part of June there were generally from ten to twenty of these vessels anchored head and stern in a line, and secured to the shore on the Floriana side of the quarantine harbour; and although no cases of cholera had occurred in them subsequently to their arrival in Malta, still their crews, by the regulations of the port, were required to get the whole of their wearing apparel and bedding on deck, and to expose them thoroughly to the air. Immediately over the place where they lay, is situated the Ospizio, an extensive poor-house, which at that time contained about 700 aged persons of both sexes, among whom, on the 9th of June, the disease first made its appearance. On that day two fatal cases occurred, and it is important to remark, that both patients occupied the apartments in the building nearest to the Neapolitan vessels, from which, indeed, they were only separated by a wall perforated by loop-holes for the admission of air." On the following day, the 10th, there were 5 cases; on the 11th there were 4; on the 12th, 12; on the 13th, 14; on the 14th, 11; on the 15th, 32; on the 16th, 53, and on the same day a case occurred in a Turkish corvette, which had arrived from Tunis eight days previously, and anchored near the line of Neapolitan vessels; but being also in quarantine, she had not had any communication with the other vessels in the harbour or with the island. On the 17th, 44 cases occurred in the Ospizio: making the total number of attacks since its eruption, 180, and the total number of deaths, 114; and yet up to this date not one case had occurred on the island beyond the walls of the building. This, as regards the supposed origin and spread of the disease from an epidemic constitution of the atmosphere, it is important to remember; for if its eruption and extension depended entirely on aërial causes, it will be extremely difficult to explain why it did not appear in other parts of the island.

On the last-mentioned date, however, (viz., the 17th,) the

disease at length broke out in Floriana, one of the suburbs of Malta. A soldier of the 95th Regiment, which occupied barracks contiguous to the Ospizio, and a woman residing in a street also in close approximation to the same building, were its first victims. On the 18th there were fifty-five new cases in the Ospizio, and one outside in a detachment of the Royal Artillery, the patient having been exposed to the exciting cause, while on fatigue duty in Floriana. On the 19th, the attacks in the Ospizio amounted to 60; and on the 21st to 57. On the same morning the disease made its appearance in Her Majesty's steamer Hermes, which had arrived from England *viâ* Gibraltar on the 17th, and anchored near the Turkish corvette, and almost in contact with the Neapolitan vessels.

Now, in this instance, how are we to reconcile the eruption and spread of the disease with the presence of a general aërial cause—an epidemic constitution of the atmosphere? Cholera, as we have seen, existed in Naples; but up to the day on which it broke out among the paupers in the Ospizio, not a case had made its appearance in Malta. Did the cause, then, approach the island from some source exterior to it, and, after passing by the vessels in the harbour, first impinge itself against the walls of the Ospizio, or was it a production of the soil, or of the atmosphere within the building, which, by some peculiar unknown influence, became attached to the spot for the space of at least eight or nine days subsequently to its evolution? Was the eruption of the disease in the Ospizio, in the Turkish corvette, and in the steamer Hermes—the three points nearest to the vessels which had come from Naples, where the disease did exist—merely the accidental effect of a general atmospheric cause, and in no way connected with the Neapolitan vessels? To any of these questions it would perhaps be difficult to append a satisfactory answer,—but, as we have no reasonable proof that there ever did exist a specific condition of the atmosphere capable of producing cholera, or that there ever was evolved from the earth, or engendered in the air, a cause capable of producing it,—and as the spread of the disease subsequently to its evolution was most dis-

tinctly but little, if at all, influenced by atmospheric currents, it seems as if we might as well attempt to account for the appearance of the disease in Malta by the presence of some morbific agent, which had issued from the crater of the neighbouring volcano; although, even in that case, it would still be difficult to understand by what law or influence it acquired the power of attaching itself to a particular spot, while the air in which it was contained swept rapidly away to leeward. It is not necessary again to refer to the supposed co-incidental eruption of the disease with the arrival of the vessels from Naples, or to the singular, or rather, the significant fact of its first attacking the three different and distinct communities of men nearest to them; for, let us reason as we may on these facts, there is, if we reason fairly, but one conclusion that we can come to at last, and that is, that the germs of the disease were shaken from the clothing or the bedding of the Neapolitans, that it was wafted in through the loop-holes of the Ospizio upon the aged inmates, producing several cases almost simultaneously in the first instance, by which the infectious virus was again produced, and speedily disseminated by the production of other succeeding cases to all parts of the building, and then in the same manner, after a lapse of eight days, to the suburb of Floriana, to Valetta, to the shipping in the harbour, and subsequently to almost every town or hamlet on the island, and, at length, after a lapse of time, to the adjacent island of Goza.

There is yet another circumstance which requires to be explained by those who attribute epidemic cholera to the presence of a general atmospheric cause; and that is why, in insular positions, and in certain countries in which the disease is not indigenous, it generally, if not invariably, first makes its appearance in seaport towns. In this country it has twice broken out in or near ports on the north-eastern parts of the island, and in London. In America, it first appeared in New York and New Orleans; in Canada, at Quebec and Montreal; in Nova Scotia, at Halifax; in Cuba, at the Havannah; in Malta, at Valetta; and in every instance these several ports were, at the time it appeared, in direct commu-

nication with other ports in which the disease existed, and from which suspected vessels had arrived.

The constancy of these results certainly forms a singular contrast with those which might be expected to occur from an agent driving with the wind in every direction over the surface of the globe.

Cholera, or the cause of cholera, until very recently, had never, so far as we know, reached the West Indian islands; at length, however, it manifested itself in Cuba; and in September last it was extremely fatal on the shores of the Spanish Main, particularly at Chagres. Where it would wander to next no one could tell; but there was no reason why it should not visit Jamaica. Around this island there are numerous seaports, and there are towns and villages at no great distance from the shore; each of these was equally exposed to be assailed by an aërial epidemic cause, if it came from Chagres, or from any other place exterior to the island; and if it came from sources within the island, it was as likely to be evolved in one town as in another. Thus we shall suppose the people of Jamaica not believing it possible to protect themselves against the invasion of a general atmospheric cause, which had spread with such destructive force over almost every other region of the world, adopted no precautionary measures, but were calmly awaiting its arrival, when a steam-packet, after a voyage of two-and-a-half days from Chagres, steered into Port Royal. Two passengers landed from this vessel, who subsequently, it is stated, suffered from intermittent fever; there was also some foul linen landed: she took in a supply of coals, and, after enjoying free pratique for about four-and-twenty hours, again went to sea. A few days after her departure the inhabitants of Kingston were astounded by a report that the same destructive agent which was desolating Chagres had gained a footing on the island. Now, of all the ports and creeks which indent the shores of Jamaica, it will, to those who adhere to the theory of an epidemic constitution of the atmosphere, surely appear somewhat singular that Port Royal should be the one in which the disease first made its appearance, and that the first cases should occur in two

houses at no great distance from the wharf where the steamer took in her coals, and only a few days after she left the port. It is not necessary to offer any opinion as to how the epidemic cause reached Port Royal; the facts were as they are here stated. Some may suppose that it came from without, and that its entering the same port with the steamer was a mere "coincidence," and that it only obeyed a particular law by "localising" itself for eight days at Port Royal before it passed on to Kingston; others may suppose that it was developed on the spot, and subsequently, a week later, at Kingston, which is six miles distant; and then, in the course of another week, at Spanish town, which is still further inland; there are many who will in some way or other attempt to connect the epidemic cause which subsequently extended over the whole island, with the filth which has been the opprobrium of Port Royal for at least the last two hundred years; and there may be a few who will attribute to the steamer the introduction of the disease into Port Royal, supposing that the infectious poison was conveyed from Chagres in the form of fomites, or that it emanated from some person or persons in the steamer, who, at the time of her arrival, laboured under undeveloped cholera, or who were suffering from choleraic diarrhœa.

In another part of this paper an attempt has been made to show that the laws which govern the epidemic spread of small-pox, are the same as those which govern the epidemic spread of Asiatic cholera; but, when the latter, as regards these phenomena, is compared with yellow fever (the infectious nature of which will hardly now be disputed) the similarity becomes still more striking. For instance, in their epidemic form, they both seem to originate from one, or at all events from a few cases occurring sporadically, and spread to places far distant from the site of their origin; their extension being greatly facilitated by intercourse, if not entirely dependent on it. They both infest low, damp, dirty localities, and in proportion to their rifeness in such places, so are their virulence and reproductive powers increased. They both speedily exhaust towns or localities of susceptible persons, when they gradually decline, and be-

come extinct,—or pass on to other places not far distant. In both there appear to be occasionally partial remissions or lulls, and aggravations in the force of the epidemic, as if from some contingent circumstance, the infectious principle alternately lost, and acquired an accession of power. This may also happen when a number of susceptible persons arriving from a healthy district, are suddenly placed within the range of the poison in the infected locality.

Both epidemics are frequently preceded by what may be termed a period of maturation, during which the morbid action, weak at first, gradually increases in force. Before an invasion of yellow fever, it is by no means uncommon for diarrhœal complaints to prevail, together with an aggravation of the common fevers peculiar to the locality. Cholera has also almost invariably had its precursors in the form of diarrhœa, cramps, catarrh, and other anomalous ailments. Again, when a case of the former is attended with black vomit, it is time to adopt precautionary measures against contamination; for, if not before, it then, most indubitably, ought to be suspected of infectious properties: and, in the same manner, when a case of choleraic diarrhœa occurs with collapse, cold breath, and the characteristic blue skin, there is every reason to fear it has also acquired a similar character. Numerous sporadic cases of both diseases may occur, and no epidemic follow; the peculiar emanations in these instances become scattered and lost, without producing any effect, or, at most, not causing more than a few cases of slight fever in the one instance, and of diarrhœa in the other. Still, whether yellow fever unattended by black vomit, or cholera in its milder form, may not have infectious properties is a question respecting which we have not sufficient data to give an opinion.

In conclusion, from all the facts now known respecting this disease,—epidemic cholera,—it is presumed the following deductions may be fairly made, viz.:—

As cholera does not, as a general rule, extend with, and in the direction of, atmospheric currents, breaking out consecutively at shorter or longer intervals of time, according to the distance and the velocity of the wind, in places situated

to leeward of those in which it first makes its appearance, and over which places the same aërial current must necessarily pass; but, on the contrary, as it has generally in its epidemic course progressed with as much rapidity in a windwardly as in a leewardly direction, or in any other direction, it becomes clearly evident, that the disease cannot be the product of any cause generally diffused throughout the atmosphere.

As cholera, both in this country and in America, as well as in all European and American islands, where it is not indigenous, has invariably made its appearance first in sea-port towns which were at the time in direct communication with other distant towns or ports in which the disease existed,—as it has never broken out in the centre of any one of these islands, and extended to its circumference, —in the interior of America, and extended to its exterior,— we are bound to conclude, that it has never acquired epidemic force in either of these countries, or in the islands adjacent to them, unless when introduced by vessels coming from infected ports.

This conclusion appears to be inevitable; because, even admitting that at all times, and on every occasion, it has been the product of an aërial cause—an epidemic constitution of the atmosphere—it will nevertheless be impossible to explain, by any known rule or law in physics, why that peculiar condition or constitution of the atmosphere, whether it came from seaward, from desolate tracts of land, —whether it was generated in the air at the place, or escaped from the earth, should invariably first manifest itself in sea-port towns, and not in other towns on the sea shore, in towns more inland, or in the interior, these being equally exposed and equally liable to be the first recipients of any general epidemic influence or cause evolved from the earth, or moving in connexion with the atmosphere.

Like measles, small-pox, scarlatina, and yellow fever, cholera occasionally occurs sporadically; but whether from causes internal or external to the body there are no means of ascertaining.

It spreads epidemically only by an infectious principle, which, it is assumed, is generated and evolved to a greater or

less extent in every case, whether occurring sporadically or not; the virulence of the poison being in a direct ratio with the amount of morbid action and its force, or reproductive power, in proportion to the number of cases contained within a given space.

The exciting virus, where the cases are numerous and the ventilation defective, may take effect at the distance of one or two miles, if not further; but, in contact with inanimate substances it may be conveyed to the distance of many hundred miles, provided the transit be accomplished within the space of about ten days.

Seeing that it has never made its appearance in this country until after it had for some time—for two, three, or four months—prevailed on the Continent, there is every reason to believe that in future its introduction may be prevented by placing judicious quarantine restrictions on vessels coming from infected ports; and further, as its powers of reproduction differ in different places, as they increase in a direct ratio with the increase of cases; and, again, as the number of cases increase in proportion as the inhabitants are suffering from mental and physical depression, it becomes evident that to prevent, or at all events to retard, the extension of the disease and diminish the number of cases in those countries into which it has been introduced, it will be necessary to limit as much as possible the intercourse between a healthy and an infected locality,—to prevent all unnecessary intercourse between those that are suffering from the disease and those that are still free from it, and to improve the healthy condition of the inhabitants of places situated at low levels by the removal of accumulations of filth, by improved ventilation in their dwellings, and by an increased amount of wholesome nutritious diet.

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